SRI's Approach to Multimodal Sensing of Stress for Stress Resiliency Training

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Spending for Period 12

1 *Update: Technical Progress and Accomplishments for Period 12 (December 2012):*

Task 3.1: Capture Behavioral Stress Markers in Real-Time in Lab Environment with graded exposure to ICT's scenarios MAC 1-6

During this reporting period, we refined the magnitude estimation approach in the facial response measurement software and implemented a median filter based technique for establishing the neutral face in extended live recordings of spontaneous reactions. We now describe each of these in more detail.

Magnitude Estimation

As reported during the last contract period, for classification, the reference vector with the smallest angular difference from the test vector is returned, while for magnitude estimation, the length of the test vector is returned. During this period, an additional magnitude measure of interest was implemented: the length of the test vector as projected onto each of the reference vectors; i.e. by multiplying the test vector length by the cosine of angular difference between test and reference. Intuitively, this measure reports the estimated magnitude of each of the classified expressions.

Figure 1 shows a typical result within the industry standard Cohn-Kanade datatase (Lucey et al, 2010) in which the projected magnitude onto each of the reference vectors is plotted as a function of frame number. Figure 2 shows a full confusion matrix for this database, in which classification based on highest projected magnitude is shown against ground truth.

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During the next reporting period, we will be using this algorithm to estimate these projected magnitudes on our own data captured last period, and we will then use these magnitudes in developing the facial response measure based stress predictor.

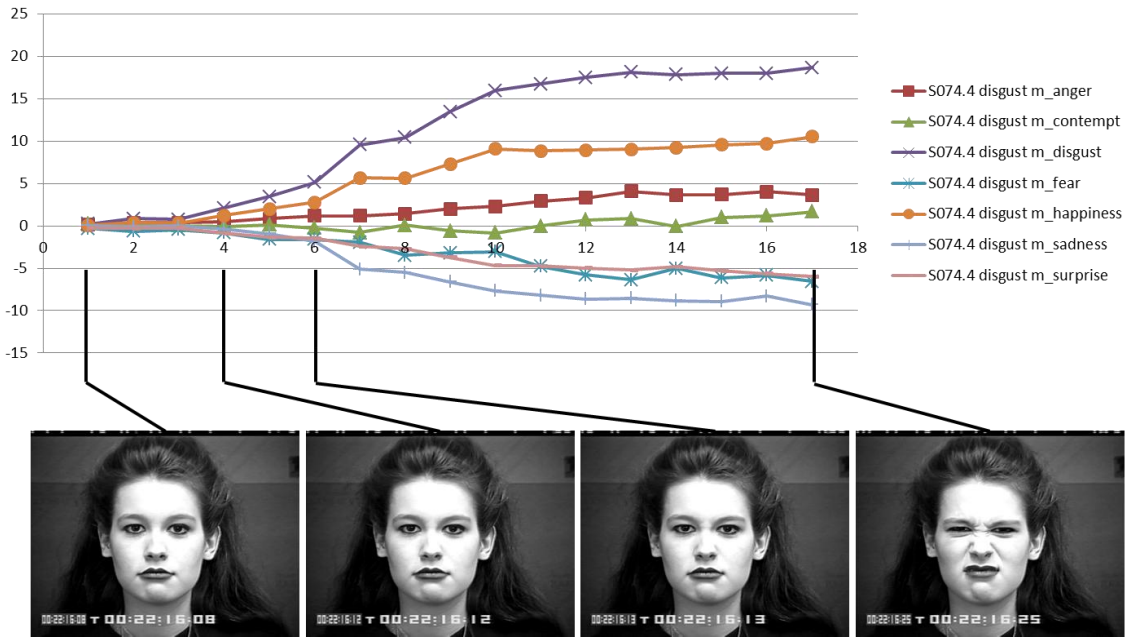

Figure 1. Typical results of vector analysis classification and magnitude estimation approach on Cohn-Kanade database, showing projected magnitude for each expression as a function of frame number. In the legend, first expression name indicates ground truth, second indicates reference vector under comparison.

Vector Classifier	Ground truth: anger	contempt	disgust	fear	happiness	sadness	surprise
anger	**26**	**3**	**2**	**1**	**0**	**3**	**0**
contempt	**3**	**13**	**0**	**0**	**0**	**1**	**3**
disgust	**5**	**0**	**51**	**0**	**1**	**0**	**0**
fear	**0**	**0**	**0**	**20**	**0**	**2**	**4**
happiness	**0**	**1**	**1**	**2**	**65**	**3**	**0**
sadness	**6**	**0**	**0**	**0**	**0**	**16**	**1**
surprise	**2**	**1**	**0**	**1**	**0**	**1**	**70**

Figure 2. Confusion matrix showing classification results of vector analysis approach against ground truth in Cohn-Kanade database

Neutral Face Estimation

The facial response analysis algorithm requires an estimate of a neutral face, from which deviations of feature point locations are used in classifying and estimating response magnitudes. For the results shown in Figure 1 and 2 above, a simple approach of basing the neutral face on the first frame in each sequence was used and is appropriate, since these posed data were collected with a neutral start imposed as a constraint.

However, for naturalistic data analysis, it is important to have a robust neutral face estimate that is not overly sensitive to starting conditions. For this purpose, we have implemented an approach that continually tracks the median response of each feature over time, and uses this median as the current estimate of neutral. This approach works well for spontaneous response analysis, which tends to be bursty and hence deviates only occasionally from the median value, which therefore itself remains constant over time.

Task 3.2: Administer Scenarios and Verify Hypothesis **MAC 6-12**

Not yet at this stage.

Task 3.3: Program Management **MAC 1-12**

2. Issues:

- No current issues.

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